CROSS TRAINER EXERCISE APPARATUS

RELATED APPLICATIONS

[01] This application claims the benefit of priority under 35 USC Section 119 to U.S. provisional patent application serial no. 60/534,904 filed January 8, 2004, the disclosure of which is incorporated herein by reference in its entirety as if fully set forth herein. This application is also a continuation in part of and claims the benefit of priority under 35 U.S.C. Sections 119 and 120 to U.S. patent application serial no. 10/294,017 filed November 13, 2002 which claims priority to Provisional application no 60/337,498 filed November 13, 2001. The disclosures of all of the foregoing applications are incorporated by reference herein in their entirety as if fully set forth herein.

FIELD OF THE INVENTION

[02] The present invention relates to physical exercise machines and more particularly to an exercise apparatus that enables users to perform a simulated walking, running or other back and forth leg movement exercise.

BACKGROUND OF THE INVENTION

[03] Exercise machines for simulating walking or running are known and used for directing the movement of a user's legs and feet in a variety of repetitive paths of travel. Machines commonly referred to as elliptical path machines have been designed to pivot the foot pedals on which the user's feet reside causing the pedals and the user's feet to travel in an elliptical or arcuate path. The angular degree of pivoting of the foot pedals in such elliptical or arcuate machines changes as the foot pedal travels from back to front and front to back along the path of travel or translation of the user's foot, by typically more than about 3 degrees and more typically more than 10-30 degrees. The path of travel of the foot pedal in such machines is not adjustable other than to change the shape of the ellipse. The foot travels along a different path from back to front than from front to back in such elliptical machines. There is no provision in such prior apparati for incorporating upper body exercise. There is no provision of a handle

or hand grip that is interconnected to a foot pedal which together move/pivot simultaneously in the same back or forth direction.

SUMMARY OF THE INVENTION

[04] In accordance with the invention there is provided an apparatus for simulating a back and forth leg movement, the apparatus comprising:

[05] a pair of pivotable support mechanisms supported on a frame,

[06] a pair of foot pedals mounted on the support mechanism for back and forth movement along an arcuate path of translation movement,

[07] wherein the pedals have a generally planar foot sole receiving surface and wherein the foot pedals are pivotably mounted in an arrangement on the support mechanisms such that the sole receiving surfaces of the foot pedals pivot or rotate less than about three degrees during the back and forth movement of the support mechanisms and preferably less than about 2.5 degrees.

[08] The foot pedals are preferably mounted in an arrangement on the support mechanisms such that the sole receiving surfaces remain generally coplanar with a fixed reference plane during the back and forth movement of the support mechanisms.

[09] The support mechanisms preferably comprise a pair of four bar linkage mechanisms that each have opposing back and front link lengths that are substantially equal to each other and opposing upper and lower link widths that are substantially equal to each other. The foot pedals comprise or are otherwise mounted on the lower link of each four bar linkage.

[10] There is also provided an apparatus for simulating a back and forth leg or foot movement, the apparatus comprising:

[11] a pair of pivotable support mechanisms supported on a frame,

[12] a pair of foot pedals mounted on the support mechanisms for back and forth movement along an arcuate path of translation movement,

[13] wherein the pedals have a generally planar foot sole receiving surface and wherein the foot pedals are pivotably mounted in an arrangement on the support mechanisms such that the sole receiving surfaces of the foot pedals pivot or rotate less

than about three degrees during the back and forth movement of the support mechanisms. The foot pedals are mounted in an arrangement on the support mechanisms such that the sole receiving surfaces remain generally coplanar with a fixed reference plane during the back and forth movement of the support mechanisms.

[14] Further in accordance with the invention there is provided, an apparatus for simulating a back and forth leg or foot movement comprising:

[15] a pair of foot pedals each having a foot sole receiving surface,

[16] the foot pedals being mounted on a frame for movement in a back and forth direction along an arcuate path between forwardmost and rearwardmost positions; a pair of manually graspable input arms and/or handles each pivotably interconnected to a respective one of the foot pedals for pivoting movement in the same back or forth direction as an interconnected foot pedal moves;wherein pushing or pulling of an arm and/or handle by a user in the back or forth direction inputs force or energy to movement of a pedal interconnected to an arm and/or handle.

[17] There is further provided an apparatus for simulating a back and forth leg or foot movement comprising a pair of left and right foot pedals each having a foot sole receiving surface, the foot pedals being mounted on a frame for movement in a back and forth direction along an arcuate path between forwardmost and rearwardmost positions;

[18] a pair of left and right handles for being grasped by a user's hands each pivotably interconnected to a respective one of the left and right foot pedals such the left handle pivots forwardly together with forward movement of the left pedal, the left handle pivots backwardly together with backward movement of the left pedal, the right handle pivots forwardly together with forward movement of the right pedal and the right handle pivots backwardly together with backward movement of the right pedal.

[19] In another aspect of the invention there is provided an apparatus for simulating a back and forth leg or foot movement comprising:

[20] a pair of left and right foot pedals each having a foot sole receiving surface,

[21] the foot pedals being mounted on a frame for movement in a back and forth direction along an arcuate path between forwardmost and rearwardmost positions;

[22] a pair of left and right manually graspable input arms and/or handles each pivotably interconnected to a respective one of the left and right foot pedals such that the left arm and/or handle pivots forwardly together with forward movement of the left pedal, the left arm and/or handle pivots rearwardly together with backward movment of the left pedal, the right arm and/or handle pivots forwardly together with forward movement of the right pedal and the right arm and/or handle pivots rearwardly together with backward movement of the right pedal.The foot pedals are preferably adjustable to move in an arcuate path of selected incline.

[23] The handles and/or the input arms are preferably adjustable to move in a pivot path of selected degree of pivot.

[24] Most preferably, the pedals and the handles and/or input arms are interconnected to a pivot mechanism adjustable to a selected degree of pivot that adjusts the arcuate path of the foot pedals and the degree of pivot of the input arms and/or handles.

[25] The handles and/or the input arms and the pedals are interconnected to a reciprocating mechanism that directs one of the left or right pedals to travel in the back or forth direction while simultaneously directing the other of the left or right pedals to travel in an opposite direction.

[26] The reciprocating mechanism typically comprises a rotating mechanism having a pair of pivot points, one pivot point pivotably interconnected to one of the left or right pedals and arms and/or handles and the other pivot point pivotably interconnected to the other other of the left or right pedals and handles or arms.

[27] The pivot points are typically disposed at substantially opposing 180 degree positions along a circular path of rotation, the pedals and the handles or arms being interconnected to a respective pivot point by a link mechanism.

[28] In another aspect of the invention there is provided, an apparatus for simulating a back and forth leg or foot movement comprising:

[29] a pair of left and right foot pedals each having a foot sole receiving surface,

[30] the foot pedals being mounted on a frame by linkages for movement in a back and forth direction along an overall arcuate path defined by the linkages;

[31] a pair of left and right manually graspable input arms or handles each pivotably interconnected to a respective one of the left and right foot pedals for pivoting movement in the back or forth direction;

[32] wherein the foot pedals are adjustable to move along a selected segment of the overall arcuate path between forwardmost and backwardmost positions, the selected segment of the overall arcuate path being variably selectable by the user to have a variable degree of incline.

[33] Preferably the left arm or handle pivots forwardly together with the forward movement of the left pedal, the left arm and/or handle pivots rearwardly together with backward movement of the left pedal, the right arm and/or handle pivots forwardly together with forward movement of the right pedal and the right arm and/or handle pivots rearwardly together with backward movement of the right pedal.

[34] Further in accordance with the invention there is provided, an apparatus for simulating a back and forth leg or foot movement comprising:

[35] a pair of foot pedals each having a foot sole receiving surface,

[36] the foot pedals being mounted on a frame for movement in a back and forth direction along an arcuate path between forwardmost and rearwardmost positions;

[37] a pair of manually graspable input handles or arms each pivotably interconnected to a respective one of the foot pedals for pivoting movement in the back or forth direction;

[38] wherein the handles or arms and the pedals are interconnected to a control mechanism that directs one interconnected arm and/or handle and pedal to travel in the back or forth direction while simultaneously directing the other interconnected arm and/or handle and pedal to travel in an opposite direction.

[39] Further in accordance with the invention there is provided, an apparatus for simulating a back and forth leg or foot movement, the apparatus comprising:

[40] a pair of left and right four bar linkage support mechanisms supported on a frame for back and forth pivoting movement, each four bar linkage mechanism comprising a pair of opposing forward and rearward pivot links each having a length and a pair of opposing upper and lower pivot links each having a width;

[41] wherein the lower pivot link of each four bar linkage mechanism comprises a foot pedal for back and forth movement along an arcuate path of translation movement,

[42] wherein the lengths of the forward and rearward links are substantially equal to each other and the widths of the upper and lower pivot links are substantially equal to each other.

[43] In another aspect of the invention there is provided a, method for performing a back and forth leg, foot and upper body exercise by a subject on an exercise apparatus, the method comprising:

[44] positioning the soles of the feet of a subject on a pair of left and right foot pedals adapted to be moved in a back and forth motion along arcuate paths of translation;

[45] the left and right foot pedals being respectively interconnected to left and right manually graspable handles, each handle being adapted to pivot forwardly together with forward movement of its respectively interconnected foot pedal and to pivot backwardly together with backward movement of its respectively interconnected foot pedal;

[46] wherein the subject positions a right or left foot on a respective one of the right or left pedals; and

[47] wherein the subject exerts sufficient energy to move a respective one of the left or right pedals forwardly or backwardly and to simultaneously pivot a respective one of the left or right handles forwardly or backwardly.

[48] Preferably, the subject selects the degree of incline, of the arcuate paths of translation of the foot pedals.

[49] There is also provided, a method for performing a back and forth leg, foot and upper body exercise by a subject on an exercise apparatus, the method comprising:

[50] positioning the soles of the feet of a subject on a pair of left and right foot pedals adapted to be moved in a back and forth motion along arcuate paths of translation;

[51] the left and right foot pedals being respectively interconnected to left and right manually graspable arms and/or handles, each arm and/or handle being adapted to pivot forwardly together with forward movement of a respectively interconnected foot pedal and to pivot backwardly together with backward movement of its respectively interconnected foot pedal;

[52] wherein the subject positions a right or left foot on a respective one of the right or left pedals; and

[53] wherein the subject exerts sufficient energy with a respective one of the subject's left or right arms or hands to push or pull a respective one of the left or right arms and/or handles forwardly or backwardly and to simultaneously move a respective one of the left or right pedals forwardly or backwardly.

[54] In another aspect of the invention there is provided, a method for performing a back and forth leg, foot and upper body exercise by a subject on an exercise apparatus, the method comprising:

[55] positioning the soles of the feet of a subject on a pair of foot pedals adapted to be moved in a back and forth motion along arcuate paths of translation;

[56] the foot pedals being interconnected to a frame of the apparatus such that the foot pedals rotate or pivot less than about 3 degrees during movement in the back and forth motion;

[57] wherein the subject exerts energy to move one of a left or right foot forward while standing on one pedal and simultaneously exerts energy to move the other of the left or right foot backwardly while standing on the other pedal.

BRIEF DESCRIPTION OF THE DRAWINGS

[58] The above and further advantages of the invention may be better understood by referring to the following description in conjunction with the accompanying drawings in which:

[59] FIG. 1 is a rear perspective view of a device in accordance with the invention;

[60] FIG. 2 is a front perspective view of the device of FIG. 1;

[61] FIG. 3 is a rear view of the device of FIG. 1;

[62] FIG. 4 is a front perspective view of the device of FIG. 1, shown with a housing for moving parts removed;

[63] FIG. 5 is a side view of the device of FIG. 1;

[64] FIG. 6 is a top view of the device in FIG. 1.

[65] Figure 5A is a side view of the Fig. 1 apparatus showing an embodiment where the foot pedal is essentially non-rotating between the forward and backward positions.

[66] Fig. 7 is a right side view of the Fig. 5A and/or the Figs. 1-6 embodiment showing the foot pedal 24b and link or bar 28b in their forwardmost and rearwardmost positions when the mounting member 38 for the flywheel and brake assembly, crank arms 40a, 40b and other associated components is positioned in a more backwardly pivoted position where axis X of mounting member 38 is in a nearly vertical orientation.

[67] Fig. 8 is a right side view of the Fig. 5A and/or the Figs. 1-6 embodiment showing the foot pedal 24b and linkage bar 28b in their forwardmost and rearwardmost positions when the mounting member 38 for the flywheel and brake assembly, crank arms 40a, 40b and other associated components is positioned in a more forwardly pivoted position where axis X of mounting member 38 is pivoted an angle A forwardly of the position shown in Fig. 7.

[68] Fig. 9 is a right side perspective view of the Figs. 1-8 apparati having a pair of pivotable handles pivotably attached to the forward four bar linkage legs 26a, 26d and to the frame via a support bar 500.

[69] Fig. 10 is a right side view of the Fig. 9 apparatus.

DETAILED DESCRIPTION

[70] Generally, the present invention is an exercise apparatus that provides a low impact workout yet offers the potential for an intensive cardiovascular workout by eliminating the unnatural motion and awkward foot alignments typical of many stair-climbing and elliptical training devices. The invention provides one or more foot supports movable along an arcuate path and defined around a point of rotation. The arcuate path is divisible into machine defined, user selectable arc segments. The exercise apparatus includes a frame, a frame linkage movably engaged with the frame, one or more foot supports movably engaged with the frame linkage, a crank movably engaged with the frame, a motor operative to move the crank location with respect to the frame, and a drive linkage movably engaging the frame linkage.

[71] FIG. 1 is a perspective view of an exercise device in accordance with the present invention. The device includes a frame 10 having a front region 12, a rear region 14, "legs" 16a, 16b, 16c and 16d, and upper supports 18a, 18b, 18c, and 18d. Upper supports 18c and 18d comprise the upper links of a pair of four bar linkages and part of the arcuate portion of the frame, terminate in legs 16c and 16b respectively and are an integral part of frame 10. A display/control panel 20 and hand grips 22a and 22b are secured to the upper supports 18a and 18b.

[72] Foot supports 24a and 24b are sized to receive the foot of a user. Foot supports 24a and 24b are movably connected to, and supported by, forward linkages or legs 26a and 26b, and rear linkages 26c and 26d. Linkages 26a-26d are movably connected to the rear region 14 of frame 10 by upper supports or links 18d and 18c. Although the device is shown with opposing pairs of linkages supporting each foot support, other embodiments are contemplated having fewer or more linkages supporting and controlling the range and path of motion of foot supports 24a and 24b associated with the linkage(s).

[73] The foot supports 24a and 24b approximate a shod human foot in size and shape. They can include a non-skid surface and be bounded by one or more low lips to help a shoe remain in place on the foot supports during use. Alternately, straps

may maintain each foot within the foot support to further retain the user's foot in place during use. However, as used herein, a "foot support" can also encompass any designated support such as a pedal, a pad, a toe clip, or other foot/toe/leg and device interface structure as is known in the art.

[74] The forward linkages or legs 26a and 26b are movably connected to drive linkages 28a and 28b; and the drive linkages are in turn connected to other elements (illustrated in FIGS. 3 and 4 and described below) concealed by a housing 30. In other embodiments, the drive linkages 28a and 28b are connected directly to the foot supports 24a and 24b. Additionally, "foot supports" can be on or integral to either the forward linkages or to the one or more linkages joined to the frame.

[75] As illustrated in FIG. 1, representative movable connectors 31a, 31b, 31c, and 31d include pivot assemblies, as known in the art, that provide very smooth and easy relative rotation or reciprocal motion by elements joined by the pivot assemblies. Movable connectors 31b and 31d rotatably couple forward linkages or legs 26b and 26a, respectively, to upper supports or links 18c and 18d. Movable connectors 31c and 31a rotatably couple rear linkages 26c and 26d, respectively, to upper supports or links 18c and 18d. Other connection assemblies that permit similar motion are contemplated by the invention. The movable connectors allow for a smooth and controlled swinging of foot supports 24a and 24b in an arcuate path.

[76] FIG. 2 is a front perspective view of the device shown in FIG. 1 illustrating the elements described above from a different angle. This illustration shows the device from the front region 12 perspective. Once again it can be seen that foot supports 24a and 24b are suspended from their respective linkages. Drive linkages 28a and 28b (not shown in FIG. 2) are coupled at their first ends to the substantial mid-point of front linkages or legs 26a and 26b, respectively. Drive linkages 28a and 28b are coupled at their second ends to a crank assembly (not shown) contained within housing 30, which contains the resistance assembly shown in FIG. 4 and described in greater detail below.

[77] FIG. 3 is a rear view of the device of FIG. 1. The illustration in FIG. 3 is how a user would view the device upon mounting. Foot supports 24a and 24b are positioned to allow the user to place his or her feet on the pedals. As described above,

clips or straps may be used to firmly secure the user's feet within their respective foot supports. Drive linkages 28a and 28b are coupled to either side of housing 30. Crankshaft 32 (shown in FIG. 4) projects from each side of housing 30 and is connected to each of the drive linkages via crank arms 40a and 40b. Handles 22a and 22b allow the user to steady themselves while the user's legs move in an arcuate path of motion.

[78] Monitor 20 may include displays and controls to allow the user to manipulate the intensity of the resistance to create an easier or more difficult exercise routine and to adjust the motion path of the foot supports to one that is more inclined or less inclined.

[79] In FIG. 4, where an alternate embodiment of the present invention is shown, housing 30 is not shown so that additional internal elements of resistance assembly 55 therein can be revealed. For example, the forward ends of drive linkages 28a and 28b are shown attached to crank arms 40a and 40b, which are connected to a crankshaft 32 that turns a pulley 34 in communication with other elements described below.

[80] FIG. 4 illustrates the pulley 34 mounted on the crankshaft 32. Top bearings 36a and 36b receiving the crankshaft 32 are secured to a mounting 38. Crank arms 40a and 40b are secured to each end of the crankshaft 32 and are movably coupled to the drive linkages 28a and 28b, respectively, as is known in the art. A second pulley 42, rotatably mounted on stationary shaft 44, which is mounted to frame member 38, is coupled to the pulley 34 with a belt 50. A second belt 52 couples the second pulley 42 to a brake/flywheel assembly 54, which includes a rotatable mass such as a flywheel 54a secured to the mounting 38.

[81] As shown in FIG. 4, the mounting 38 pivots around bottom bearings 46a and 46b so as to be rotatable fore and aft. A motor 56 or supplemental motor (not shown), responsive to input from the display/control panel 20, acts as a tilt actuator to tilt the mounting 38 and the elements affixed thereto. As shown, the pulley 34, the second pulley 42 and the resistance assembly 55 including a flywheel 54a rotate about an axis that is orthogonal to the longitudinal axis of the frame 10. It should be clear from the above description of the drive system that both pedals 24a and 24b are

synchronized together by the motion of crankshaft 32. It should also be noted that there are no clutches between crankshaft 32 and brake/flywheel assembly 54. This is done to allow the inertia of brake/flywheel assembly 54 within resistance assembly 55 to assist the pedals 24a and 24b through the weaker portion of the range of motion of the users leg.

[82] Although the brake/flywheel assembly 54 is the preferred component in resistance assembly 55, various other braking devices such as known to those skilled in the art can be associated with the rotatable elements to inhibit rotation thereof. The braking device may include but is not limited to any of the following: friction and air resistance devices such as fans, pneumatic or hydraulic devices, as well as various other types of electromechanical braking devices. This list is by no means exhaustive and represents only a few examples of resistance mechanisms that may be incorporated into the present invention. The configuration disclosed herein, i.e. use of a flywheel, is especially desirable because it promotes a very smooth, bilateral, reciprocal motion that is easily maintained by a device user.

[83] FIG. 5 is a side view of the device. In this view, the foot supports 24a and 24b, forward linkages or legs 26a, 26b and rear linkages or legs 26c, 26d are presented from a perspective that allows ready visualization of the path that foot supports 24a and 24b, and thus a user's feet, will traverse as the foot supports move fore and aft while suspended from the forward and rear linkages. It will be noted that as foot supports 24a and 24b move fore and aft, the forward and aft limit of motion is not unbounded. Rather, the range of motion is defined by the length of the crank arms 40a and 40b (shown in FIG. 4), which provide an appropriate stride length. Further, because the foot supports 24a and 24b are pivotally connected to, and swing with, the forward linkages 26a, 26b and rear linkages 26c, 26d, the foot supports travel a curved or arcuate path, and not an elliptical path, to provide more favorable biomechanics.

[84] The motion path for the foot supports 24a and 24b can also be altered by adjusting the position of mounting 38. As described above, the mounting 38 is pivotally mounted to the frame member 48 and pivots fore and aft upon command. As is evident by reference to the Figures, pivoting the mounting 38 forward moves the components

secured directly or indirectly thereto forward. Likewise, pivoting the mounting 38 rearward causes the components secured directly or indirectly thereto to move rearward. This repositioning causes the motion path of the foot supports 24a and 24b to move to a different location along an arcuate path around a point of rotation "p", shown here between pivot assemblies 31b and 31c, at a distance established by the length of the forward and rear linkages or legs 26a, 26b, 26c and 26d. Thus, the specific location on the arc or arc segment ("the motion path") is user selectable to increase or decrease stride angle and location from a number of user selectable points, or arc segments, defined around the point of rotation.

[85] In operation, a user approaches the device from the rear region 14, grasps the hand grips 22a and 22b, and places a foot on each of the foot supports 24a and 24b. The user's feet and legs begin to move fore and aft in a comfortable stride. The user selects an exercise program or manually adjusts the device by imputing commands via the display/control panel 20. In response to the command input, the resistance to fore and aft movement of the foot supports 24a and 24b can be altered by impeding rotation of the pulleys 34, 42 or the flywheel. Also, in response to command input, the mounting 38 is moved fore or aft. As shown, when the mounting 38 moves forward, the motion path of the foot supports is on a more inclined or vertical defined arc segment. To discontinue use of the device, a user simply stops striding, thereby causing the movement of the device to stop, and dismounts from the foot supports.

[86] Fig. 5A illustrates another embodiment of the invention showing one of the four bar linkage support mechanisms in a forwardmost, 26a', 26d' and a rearward 26a, 26d position along the pivot stroke of the four bar linkage. The four bar linkage has opposing pivot widths (or opposing pivot link, 18c/24b, 18d/24a widths), W' and W", and opposing pivot lengths (or opposing pivot link, 26a/26d, 26b/26c lengths), L' and L" that form the functional four bar linkage for purposes of pivotably mounting/supporting the foot pedal 24a from an upper portion 18d (or foot pedal 24b from upper portion 18c) of the overhead support arm or leg, 16b, 16c, of the frame. The foot pedals 24a, 24b themselves comprise a structural portion or the whole of the lower pivot link of the four bar linkages in the embodiments shown in Figs. 1-10. The distances between the width

pivot points 31a and 31d, W' and between the width pivot points 31e and 31f, W" are preferably equal or substantially equal. And, the distances between the length pivot points 31d and 31e, L' and between the length pivot points 31a and 31f, L" are also preferably equal or substantially equal such that the difference between angles A1 and A2, i.e. the degree of rotation or pivot of the foot pedal 24a from back to front and front to back along the arcuate path of translation of the foot pedal from front to back and vice versa is less than about 3 degrees, typically less than about 2.5 degrees. The foot pedals have a foot sole receiving upper surface that defines a generally planar orientation or plane in which the sole of the foot of the user is maintained when standing on a foot pedal. Angle A1 is the angle between the foot sole orientation plane PP1 in which the foot sole surface resides at the backwardmost end of the front to back path of translation and a fixed selected reference plane RP. Angle A2 is the angle between the sole orientation plane PP2 in which the foot sole surface resides at the forwardmost end of the front to back path of translation and the fixed selected reference plane RP. In this preferred embodiment, the difference between angles A1 and A2, at any point/position along the back to front/front to back path of translation of the food pedal 26a is preferably less than about 3 degrees (typically less than about 2.5 degrees), i.e. the plane in which the foot sole surface of the pedal 24a resides does not rotate or pivot more than about 3 degrees at any time during movement through the arcuate path of translation.

[87] As can be readily seen from Figs. 1-10, the foot pedals always travel in the same arcuate or other configuration of path of travel from front to rear and from rear to front. The overall arcuate path of travel J, Fig. 7, that the pedals 24 a, b may travel in remains the same regardless of what degree of pivot the arm 38 is positioned in. Pivoting the support arm 38 to different pivot positions only changes the arc "segment" (e.g. segment AP, Fig. 7, or segment AP', Fig. 8, or segment AP", Fig. 10) through which the pedals may travel from rearwardmost to forwardmost positions but does not change the overall path of arcuate travel J. The overall arcuate path of travel J is defined by the machine or apparatus itself, i.e. by the mounting, positioning, lengths and widths of the links 18c, d, 24a, b and 26a-d. The user may select a segment of the

overall machine defined arcuate path of foot pedal travel J depending on the degree of pivoting of arm 38 that the user selects for any given exercise session. As described below each segment selected will have a different degree of incline, e.g. H1 for segment AP and H2 for segment AP'.

[88] Figs. 7 and 8 more clearly illustrate the previously described selectability of the arc segment when the mounting member 38 and its associated control components 30 such as flywheel 54a, brake and crank elements is/are pivoted or tilted from one orientation to another. As shown in Fig. 7, the pivotable mounting member 38 is positioned with its longitudinal axis X arranged in about a vertical orientation. In this orientation, the maximum difference in height or incline H1 between the rearwardmost position 24 b' of the foot pedal 24b and forwardmost position 24b" of the foot pedal 24b is less than the maximum difference in height or incline H2 of Fig. 8 where the axis of the mounting member 38 and its associated components 30 have been tilted or pivoted forwardly by an angle A from the position of Fig. 7. As shown, the arcuate path AP of the pedals 24b in Fig. 7, going from position 24b' to 24b", is less steep or upwardly inclined than the arcuate path AP' of the pedals going from position 24b"' to 24b"" in Fig. 8. Thus, as shown, the user can select the degree of arc of travel of the pedals by selecting the position of tilt of assembly 30 to which the linkage bars 28b are attached.

[89] As also shown in Figs. 7 and 8 the pedals travel along the same path AP or AP' from front to rear and from rear to front.

[90] Figs. 9 and 10 show an embodiment where a pair of pivoting upper body input arms 100a, 100b are provided that the user can manually grasp by hand at an upper region such as handles 106a, 106b, the handles 106a, b being a rigidly connected extension of arms 100a, 100b respectively and moving/pivoting together with the arms forward or backward. The handles 106a, 106b and arms 100a, 100b are pivotably interconnected to both the frame and to the pedals. As shown the handles 106a, 106b and arms 100a, 100b are pivotably interconnected to the frame via a cross bar member 500, the bottom ends of the arms being freely pivotably mounted via pin/aperture joints 104a, 104b at their bottom ends, the joints being attached to bar support member 500 at appropriate distances from each other along the length of bar

support 500. Arm linkage members 102a, 102b, are pivotably attached at one end to the arms at joints 108a, 108b which allow the linkage members to rotate/pivot on and with respect to the arms. Linkage members 102a, 102b are also pivotably attached at another end to some component of the arcuate path traveling assembly of foot pedal, and four bar linkage supports 26. As shown in Figs. 9, 10 an end of the linkages 102a, 102b distal from the arm connection point are pivotably attached to the forward longitudinal four bar linkage members 26d, 26a respectively via joints 110a, 110b that allow the linkage members to rotate around the axes of the joints, the joints interconnecting the linkage members 102a, b and the longitudinal four bar linkage members 26d, a.

[91] As shown in Fig. 10, as the foot pedal assemblies 24, 26 travel along the arcuate path AP" from either front to back or from back to front, the handles 106 and arms 100 follow the front to back movement of the pedals with a pivoting front to back or back to front movement. That is, when the right pedal 24a moves forwardly the right handle 106a and arm 100a pivot or move forwardly; when the right pedal 24a moves backwardly the right handle 106a and arm 100a pivot or move rearwardly; when the left pedal 24b moves forwardly the handle 106b and arm 100b pivot or move forwardly; when the left pedal 24b moves rearwardly the handle 106b and arm 100b pivot or move rearwardly. Such following motion is shown for example with reference to four bar linkage arm 26d in three sequential front to back positions 26d1, d2 and d3 which correspond respectively to arm 100a positions, 100a1, a2, a3. The degree of front to back pivoting of the arms 100a, b can be predetermined at least by selective positioning of the pivot joints 108a, 108b, 110a, 110b, selective positioning of cross bar 500 and selection of the lengths of linkage arms 102a, 102b.

[92] In the Figs. 9, 10 embodiments,the user can reduce or transfer the amount of energy or power required by the user's legs and/or feet to cause the foot pedals to travel along the arcuate path AP" from back to front by pushing forwardly on the upper end of the arms 102a, 102b during the back to front pedal movement. And, the user can increase the speed of forward movement by such pushing; or reduce the speed and increase the power or energy required by the legs to effect forward movement by

pulling. Conversely the user can reduce or transfer the amount of power or energy required to cause the pedals to move from front to back by pulling backwardly on the upper end of the arms. And, the user can increase the speed of rearward movement by such pulling or reduce the speed by pushing; or reduce the speed and increase the power or energy required by the legs to effect rearward movement by pushing.

[93] The four bar linkage foot assemblies, 24a, 26a, d, 18d and 24b, 26c, b, 18c that are pivotably linked via the linkages 102a, 102b to the pivotably mounted arms 100a, b can be configured to enable the foot pedal and the plane in which the sole of the foot is mounted to either not rotate or to rotate/pivot to any desired degree during front to back movement by selecting the lengths L' and L" and widths W' and W", Fig. 5A appropriately to cause the desired degree of rotation/pivoting. These four bar linkage assemblies also, via the above described linkages to the arms 100a, b, cause the arms to travel along the same path of pivot from front to back and back to front.

[94] In the embodiment shown in Figs. 1-5 and 5a, 7-10, the linkages 28a, a', a", a"' and 28b, b', b", b"' are interconnected to the flywheel 54a via the four bar linkage and the linkages 28a, 28b at opposing 180 degree circle positions 40c and 40d from the center of rotation 54b of the crank arms 40a, b and/or flywheel 54a, i.e. the linkages are connected at maximum forward and maximum rearward drive positions respectively. This 180 degree opposing interconnection causes the right 24b, b', b", b"' and left 24a foot pedals to always travel in opposite back and forth translational directions, i.e. when the right pedal is traveling forward the left pedal is traveling backwards and vice versa. Similarly, the pivotably mounted arms 100a and 100b are interconnected to the flywheel 54a via the four bar linkage, the links 28a, 28b and the links 102a, 102b such that when the right arm is moving forward the left arm is moving backward and vice versa. As shown in Figs. 9, 10 the arms 100a, 100b travel forwardly or backwardly together with their associated foot pedals 28a and 28b respectively.

[95] In any event, the left and right side pedals 24a, b and input arms 100a, b are linked to the resistance or drive assembly (in the embodiments shown, the flywheel and associated crank arms) such that when the left side components (i.e. left pedal and associated input arm) are traveling forward the right side components (i.e. right pedal

associated input arm) are traveling backward for at least the majority of the travel path and vice versa.

[96] The upper body input arms 100a, b are interconnected or interlinked to the same pivotable mounting member 38 as described above via the links 102a, b, four bar linkage members 26a, b and links 28a, b as shown in Figs. 9, 10. In the same manner as forward or backward pivoting of the mounting member 38 changes the degree of incline and/or path of travel of foot pedals 24a, b as described above with reference to Figs. 7, 8, a forward or backward pivoting of the mounting member 38 also changes the degree of back to front pivoting and/or the degree of path of travel of arms 100a, b. Thus, in the same manner as the user is able to select the degree of incline of the path of travel of the foot pedals, e.g. arc path AP versus arc path AP' as shown in Figs. 7, 8 and also described above with regard to mount member 38 enabling the user to select the degree of arc segment stride length and angle/incline, the user is able to select the degree of back to front/front to back pivot stroke or travel path of input arms, 100a, b, by adjusting the front to back pivot position of the center of rotation of rotation connection/interconnection points 40c and 40d.

[97] The input arms 100a, b are linked to the foot pedals 24a, b in a manner that causes an input arm (e.g. 100a) to move forwardly as its associated foot pedal (24a) moves forwardly and upwardly, or conversely that causes an input arm to move backwardly as its associated foot pedal moves backwardly and downwardly along the user selected arc segment.